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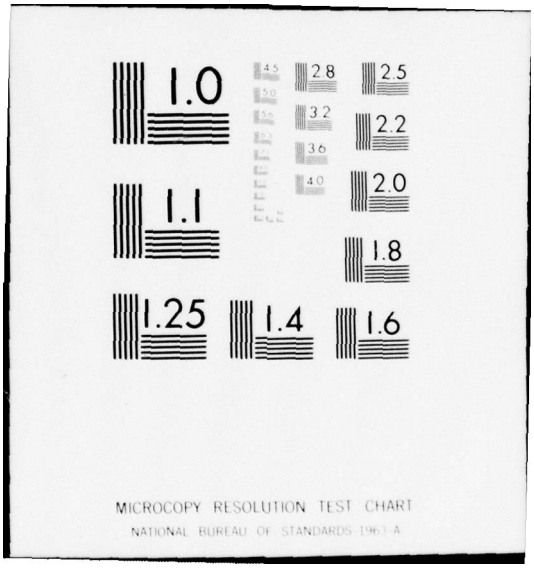
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DEFENSE SYSTEMS MANAGEMENT COLLEGE

PROGRAM MANAGEMENT COURSE
INDIVIDUAL STUDY PROGRAM

AN ANALYSIS OF THE ORGANIZATIONAL
ALIGNMENT OF THE AIR FORCE LABORATORY SYSTEM

STUDY PROJECT REPORT
PMC 76-2

Charles C. Hansult
Lt Col USAF

FORT BELVOIR, VIRGINIA 22060

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DEFENSE SYSTEMS MANAGEMENT COLLEGE

STUDY TITLE:

AN ANALYSIS OF THE ORGANIZATIONAL ALIGNMENT OF THE AIR FORCE LABORATORY SYSTEM.

STUDY PROJECT GOALS:

To examine some of the factors which affect the organizational alignment of the Air Force laboratory system, to assess the impact of assigning the laboratories to the product divisions, and to recommend an organizational structure which will be effective in the environment of the next decade.

STUDY REPORT ABSTRACT:

This study project analyzes the organizational alignment of the Air Force laboratory structure and the potential impact of realigning the structure by assigning the laboratories directly to the product divisions. The data base includes published and unpublished documents as well as information obtained through interviews with key individuals who are highly cognizant of Air Force research, development, and acquisition. The report is important to those involved in Air Force R&D management because the laboratories represent a valuable resource which, when properly utilized, can significantly enhance the systems acquisition process.

The opinion is widely held that the laboratory system is not supporting systems acquisition as much as it could. Closer coupling has been advocated, and assigning the laboratories to the product divisions has been proposed. This report explores the role of R&D in systems acquisition, examines barriers to communication which exist, outlines the advantages and disadvantages of the proposed realignment, emphasizes the need for an independent laboratory system, and suggests a management approach to optimize the employment of the laboratory resources.

The report concludes that although there are near-term advantages associated with a realignment, these advantages can be realized only at the expense of long-term capability through the erosion of the technology base. The best organizational alignment is one which enables the product divisions to influence the efforts of the laboratories through the development planning process and still preserves the independence of the laboratories by having them report directly to HQ AFSC.

The report recommends that the present structure be essentially retained. AFATL and RADC are considered separately. The command is correct in placing more emphasis on the matrix approach to program management. The laboratories should be looked upon as another functional area in the matrix with laboratory personnel collocated in the SPOs as required.

SUBJECT DESCRIPTORS: AFSC Laboratory Structure, Preservation of the Technology Base, Laboratory/SPO Interface.

NAME, RANK, SERVICE	CLASS	DATE
Lt Col Charles C. Hansuld, USAF	PMC 76-2	November 1976

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AN ANALYSIS OF THE ORGANIZATIONAL ALIGNMENT OF THE AIR FORCE LABORATORY SYSTEM

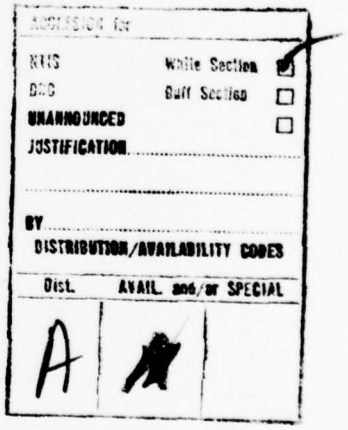
Study Project Report

Individual Study Program

Defense Systems Management College

Program Management Course

Class 76-2



by

Charles C. Hansult
Lt Col USAF

November 1976

Study Project Adivosr
Colonel Robert Lucas, USAF

EXECUTIVE SUMMARY

This study project report is an analysis of the organizational alignment of the Air Force laboratory structure and the potential impact of realigning the structure by assigning the laboratories directly to the product divisions.

This report is important to those involved in Air Force R&D management because the laboratories represent a valuable resource which, when properly utilized, can significantly enhance the systems acquisition process. Some argue that maximum improvement could be realized by hardlining the laboratories to the product divisions. Others argue that the short-term benefits to be gained by a realignment would be more than offset by the attendant costs.

This study project report addresses the forces which act on the laboratory system and the role of the system in the overall research, development, and systems acquisition process. The advantages and disadvantages of a realignment and the importance of an independent laboratory system are emphasized. Several conclusions are drawn, and some specific recommendations are provided.

The report is primarily based on published and unpublished documents, and interviews with selected key individuals in the research, development, and acquisition community. Based on this information, the conclusions are drawn that the laboratories are doing a good job and are responsive to the needs of the product divisions. In spite of evidence to the contrary, the opinion persists that the laboratories and product divisions need to be more closely coupled. Assigning the laboratories to the product

divisions would improve planning and provide a closer link to the user. Systems support and technology transfer would be enhanced, and the laboratories would be kept in the mainstream of systems development activities.

However, the advantages would be realized only at considerable cost. The most serious costs would be the erosion of the technology base and the loss of independence of the laboratories. The technology base is essential to provide long-term future capability, and independence is essential to the credibility of the laboratories. The best arrangement is one in which the laboratories come under the discipline of the product divisions but continue to report to HQ AFSC. Laboratory resources can be made available to the SPOs through collocation and a matrix approach to program management.

The report recommends the retention of the present system except in the specific cases of AFATL and RADC. The development goals and investment strategy process should be further exploited. Under no circumstances should attempts be made to pursue short-term gains at the expense of future capability. A proper balance between the preservation of the technology base and increased support to systems will more nearly optimize the use of the AFSC laboratory resources.

ACKNOWLEDGEMENTS

The author is particularly grateful to Brigadier General Gerald K. Hendricks, Director of Science and Technology, Headquarters Air Force Systems Command, and Dr. Alan M. Lovelace, Deputy Administrator, National Aeronautics and Space Administration for their willing cooperation, support, and insight into this somewhat sensitive and occasionally emotional subject. A debt is also owed to Colonel Bob Lucas for his patience, suggestions, criticisms, and general support. However, the author assumes sole responsibility for the views expressed in this report.

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SECTION I

INTRODUCTION

Purpose of the Study Project

The purpose of this study is to examine some of the factors which affect the organizational alignment of the Air Force laboratory system, to assess the impact of assigning the laboratories to the product divisions, and to recommend an organizational structure which will be effective in the environment of the next decade.

In order to improve the systems acquisition process, the Department of Defense issued the directive, DODD 5000.1, "Acquisition of Major Defense Systems," on 22 December 1975. DODD 5000.1 states:

> Underlying specific Defense systems developments is the need for a strong and usable technology base. This base will be maintained by conducting research and advanced technology effort independent of specific Defense systems development. (1:3)[1]

In the Air Force the development and maintenance of the technology base is the responsibility of the laboratories assigned to the Air Force Systems Command (AFSC). The key Air Force players in the acquisition process include the AFSC product divisions and the systems program offices (SPOs). The opinion is widely held that AFSC has not found the proper interface between the systems development community and the technology development community. This report will address the nature of that interface.

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[1]This notation will be used throughout the report for sources of quotations and major references. The first number is the source listed in the List of References. The second number is the page in the reference.

Specific Goals of the Study Project

The specific goals of the study project include:

- Understand the role of research and development and the laboratories in the systems acquisition process.

- Ascertain if there is a need for closer coupling between the laboratories and the product divisions.

- Examine some barriers to communication which hamper improved relations between the SPOs, product divisions, and the laboratories.

- Determine the causes for constantly shifting emphasis on research in the Air Force and show how this emphasis affects the organizational structure.

- Outline the advantages and disadvantages of assigning laboratories to the product divisions.

- Examine the need for independence of the laboratories.

- Determine which approach will better employ laboratory resources in support of systems development acquisition while protecting the technology base.

Scope and Limitations of the Study Project

Although the Department of Defense is concerned with the efficiency and effectiveness of the laboratories throughout all of DOD, this study is limited to those Air Force laboratories which are normally associated with the development of new systems for the Air Force. The aeromedical laboratories; those laboratories which do not receive funding and direction through the Office of the Director of Science and Technology, HQ AFSC; and the Federal Contract Research Centers are not included.

The assumption is made that the reader is familiar with the organizational structure and machinery of the AFSC systems acquisition process.

Methodology

The material for this study was gleaned from three major sources: documentation such as letters, regulations, and reports; the author's personal knowledge and experience; and interviews with appropriate decision makers and recognized authorities.

One of the primary documentary sources used is the Report of the Special Study Group on the Utilization of Air Force Laboratories (AFLUS). This study was performed in 1974 in response to direction from the Director of Defense Research and Engineering (DDR&E) to each of the Assistant Service Secretaries for Research and Development. The services were asked how to improve the manner in which the laboratories are utilized and how to improve the management of the laboratories with the objective of maximizing performance at whatever level of involvement results. (19:17) The AFLUS, under the leadership of Major General Kenneth R. Chapman, Commander, Air Force Eastern Test Range, Patrick AFB, Florida, was chartered to assess the present Air Force laboratory operation and structure in terms of contribution of output to Air Force hardware and people programs and to suggest steps that could be taken to improve the relevance and quality of the output while minimizing the cost of supporting the laboratories. (19:17)

Another important documentary source is material from a study on the Air Force Systems Command reposturing actions which were proposed for FY 1976. This data is significant because the primary purpose of the

proposed changes to the laboratory structure, both at the Electronics Systems Division (ESD) and at the Aeronautical Systems Division (ASD), was to align the laboratory effort more closely with the needs of the product divisions. (2:TAB 4, p. 9)

The author also draws upon his experience in the Air Force laboratory system -- both as a staff officer at the Air Force Materials Laboratory and as the Executive Officer to the Director of Science and Technology, HQ AFSC. During three years in the capacity of Executive Officer, the author had a working relationship with top and middle management people in the laboratory, systems development, and development planning organizations of AFSC.

The most important and useful information was obtained through the personal interviews conducted with people who are intimately familiar with all aspects of the issues involved. One could not expect to find more knowledgeable, highly qualified, erudite, and cooperative individuals anywhere. Their contributions are especially significant because their opinions are timely and perceptive. Since the issues here revolve around people and attitudes, their insights provide an assessment to be found in no other source.

Definitions and Abbreviations

ADTC	Armament Development and Test Center
AFAL	Air Force Avionics Laboratory
AFAPL	Air Force Aero-Propulsion Laboratory
AFATL	Air Force Armament Laboratory
AFCRL	Air Force Cambridge Research Laboratories
AFFDL	Air Force Flight Dynamics Laboratory
AFHRL	Air Force Human Resources Laboratory
AFGL	Air Force Geophysics Laboratory
AFLUS	Report of the Special Study Group on the Utilization of Air Force Laboratories
AFML	Air Force Materials Laboratory
AFOSR	Air Force Office of Scientific Research
AFRPL	Air Force Rocket Propulsion Laboratory
AFSC	Air Force Systems Command
AFSC/DL	Director of Science and Technology at HQ AFSC
AFSC/DLX	Director of Plans and Programs at HQ AFSC
AFSC/SD	Deputy Chief of Staff/Systems at HQ AFSC
AFSC/XR	Deputy Chief of Staff/Development Plans at HQ AFSC
AFWAL	Air Force Wright Aeronautical Laboratories
AFWL	Air Force Weapons Laboratory
AMRL	Aerospace Medical Research Laboratory
ASD	Aeronautical Systems Division
C^3	Command, Control and Communications
DCP	Decision Coordinating Paper
DDR&E	Director Defense Research and Engineering

DDR&E (R&AT)	Deputy Director Defense Research and Engineering for Research and Advanced Technology
DSARC	Defense Systems Acquisition Council
DOD	Department of Defense
FJSRL	Frank J. Seiler Research Laboratory
IR&D	Independent Research and Development
PM	Program Manager
PMO	Program Management Office
R&D	Research & Development
RADC	Rome Air Development Center
SAFRD	Assistant Secretary of the Air Force for Research & Development
SAM	School of Aerospace Medicine
Technology Base	- The Research (6.1), Exploratory Development (6.2), & non-specific systems related Advanced Development (6.3A) Programs
USAF/RD	Deputy Chief of Staff/Research and Development at HQ USAF
6.1	Research Program
6.2	Exploratory Development
6.3	Advanced Development
6.3A	Advanced Development not related to specific systems
6.4	Engineering Development

SECTION II

BACKGROUND

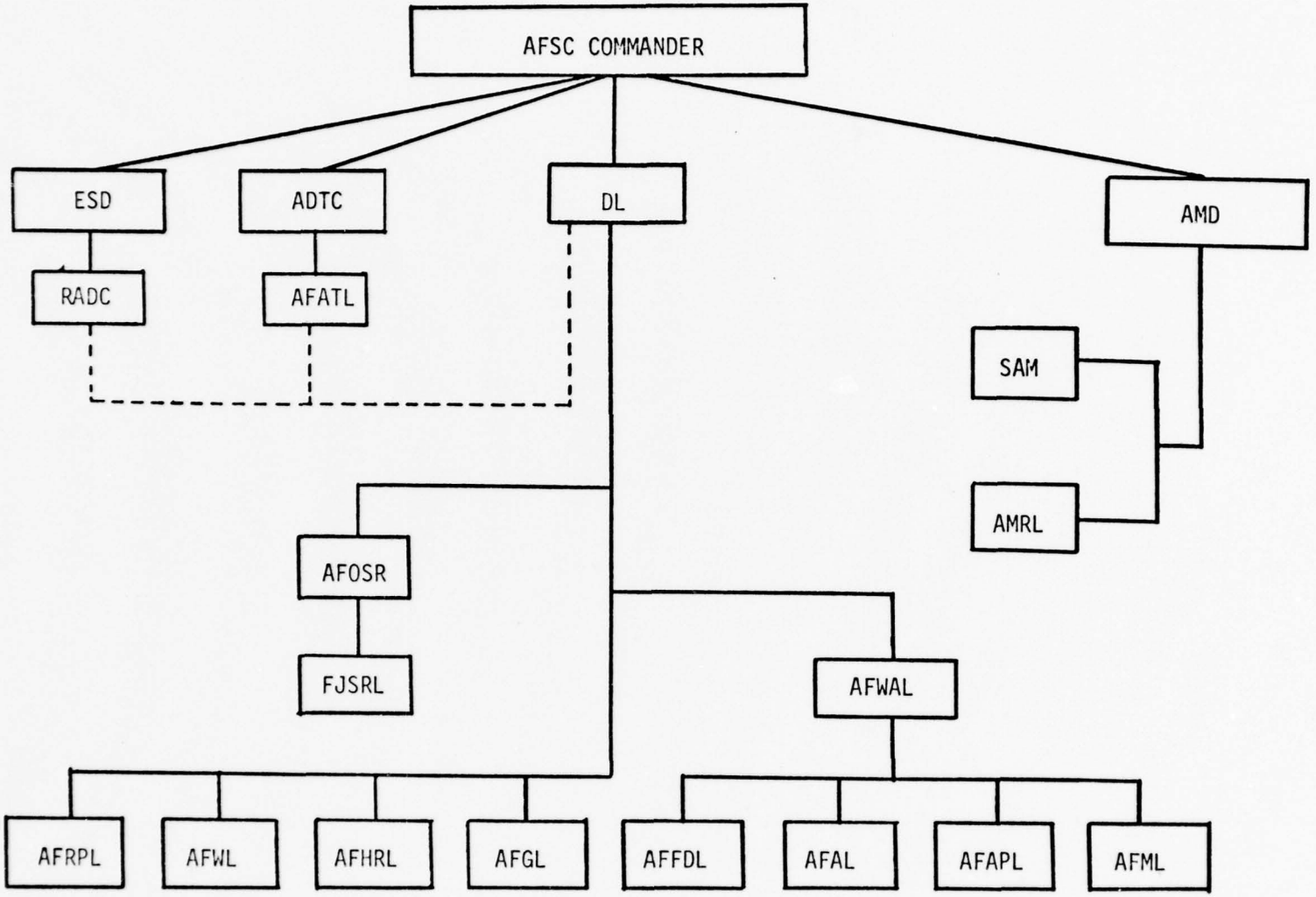
Role of Air Force Research & Development

According to the AFLUS, the primary mission of AFSC is to develop and acquire new weapons systems for the Air Force. This is accomplished by the SPOs in conjunction with industry. The secondary command mission is to "advance aerospace science and technology." (19:51) The laboratory system is primarily intended to accomplish the secondary command mission through activity in the areas of basic research, exploratory development, and advanced development. The laboratories' secondary role is to support the development and acquisition of systems.

As far back as 1960 there was uncertainty about the proper role of research and development in the systems acquisition process. (16:5) The concepts of basic research, applied research (exploratory development), advanced development, and direct support to systems apply today as they did then. Only the relative emphasis has changed. Indeed, as will be discussed later, the relative emphasis is constantly changing. The best one can hope to do is try to capture the proper role of Air Force research and development at the time of interest. Of primary concern is the way the Air Force laboratory system fits into the overall acquisition process.

Air Force Laboratory System

As a result of the AFLUS and AFSC reposturing actions, the Air Force laboratory structure was realigned into the organization depicted in Figure 1. Four of the technology laboratories at Wright-Patterson AFB, Ohio, were reorganized into the Air Force Wright Aeronautical Laboratories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AFGL
AFFDL
AFAL
AFAPL
AFML

FIGURE 1

(AFWAL) in order to better serve as a technical center in support of ASD. Although they now report to HQ AFSC/DL through AFWAL, the Wright-Patterson laboratories have managed to retain their individual identities in spite of the realignment.

The Air Force Office of Scientific Research (AFOSR) was designated as the single manager of all 6.1 basic research. Most of the 6.1 work is contracted to colleges, universities, and industry; however, AFOSR funds some 6.1 activity which is performed in-house at the various laboratories. FJSRL, the only laboratory which is totally dedicated to 6.1, reports directly to AFOSR.

The other laboratories of interest which do not report directly to DL are RADC and AFATL. Although not in the direct chain of command, DL does retain technical cognizance and control of 6.1, 6.2, and some 6.3 funding for RADC and AFATL. These laboratories will be discussed in more detail in Section III.

The AFLUS acknowledges the fact that the Air Force laboratory system is widely thought to be the best in the Federal Government. The laboratories are held in very high regard by their primary customer, the Air Force systems development community. (19:59) Brigadier General Gerald K. Hendricks, the current Director of Science and Technology, points out that the Air Force laboratories are organized to operate in a full spectrum environment. They are involved from 6.1 basic research, through 6.2 exploratory development and 6.3 advanced development programs in support of the technology base. In addition, the laboratories provide direct support to systems. (8:-)

As the Director of Science and Technology, Gen Hendricks wears two hats. He is the equivalent of a Deputy Chief of Staff for Laboratories to the Commander, AFSC, and he controls the majority of the 6.1, 6.2, and 6.3A funds for the command. In his other capacity, Gen Hendricks serves as the line commander of those laboratories which report to HQ AFSC/DL. He has command authority over nine laboratories (including FJSRL) and AFOSR, 6700 military and civilian personnel, and an annual budget of 704 million dollars. In addition, he has technical responsibility for the efforts of 2000 military and civilian personnel and a budget of 209 million dollars at AFATL and RADC. (6:-)

At the present time, the Air Force laboratories are institutionally funded by single program elements for each laboratory. AFGL, AFOSR, and FJSRL are funded by 6.1 program elements; and the remainder are funded by 6.2 program elements. Approximately 50% of the program element funds go to pay the salaries of the in-house civilian personnel. (19:42) In comparison, the Navy laboratories are industrially funded by their customers. The Navy laboratories are, therefore, more closely associated with the end products and the associated follow-on support. The Navy is organized to invent, put in the inventory, and support in the field. A great deal of duplication from laboratory to laboratory results. (8:-)

The Air Force laboratory system is leaner and more clearly defined. It cannot afford the luxury of duplication of effort. The onus for determining emphasis is placed on the laboratory, not on the customer. Because of these factors, Gen Hendricks believes that the Air Force laboratories comprise the best system for generating new technology among all the DOD laboratories (8:-)

Although the laboratory commanders have a great deal of authority in structuring their own projects and the interface with their customers, HQ AFSC exercises control through the budgetary process. The review and approval chain for Air Force R&D programs extends from the individual laboratories to DL, HQ AFSC, HQ USAF/RD, SAFRD, and DDR&E (R&AT). (19:42) The objective that 70% of the effort be conducted extramurally and 30% be conducted in-house has been achieved. (19:43) The laboratory directors also have a small pot of discretionary funds with which they may exploit particularly promising areas of technology. They are accountable only to SAFRD for these funds. (19:42)

Role of the Air Force Laboratories

In order to fully assess the impact of altering the command alignment of the laboratory structure, one must first have an understanding of the basic role of the laboratories in the systems acquisition process. This is easier said than done, however. There are almost as many perceptions of what the laboratory roles <u>are</u> and <u>ought</u> to be as there are observers. This section of the report will attempt to place the issue in perspective.

The present Director of Defense Research and Engineering, Dr. Malcom Currie, has said on numerous occasions that the chief role of the DOD laboratories is to make the DOD components "super educated buyers" who look to industry for ideas. (8:-) This is a widely held view which is generally accepted. Unfortunately, it does not tell us enough.

The AFLUS report states that the Air Force laboratory complex is intended to be a bridge connecting the advanced technology requirements of Air Force system projects to the US industrial research and development

capability. The laboratories interpret the weapons system significance of changing technology to the service users. They then interpret the service needs to the industrial base. (19:40)

Air Force Regulation 80-3, "Management of Air Force In-House Research and Development Laboratories," states that the in-house laboratory is a designated organizational element established to provide the Air Force with scientific, engineering, and analytical support in creating new weapons, vehicles, and equipment and in developing future concepts. (15:1) AFR 80-3 outlines laboratory responsibilities as follows:

a. Assuring that critical discoveries, innovations, and inventions are identified for rapid exploitation by the Air Force.

b. Participating in planning and implementation of the acquisition of systems, subsystems, and equipment for use by the operational forces.

c. Resolving technical deficiencies encountered in development programs.

d. Providing technical input to long-term military planning and decision making.

e. Evaluating performance of military equipment. (15:2)

The AFLUS states that the accomplishment of the laboratories' primary mission of maintaining a viable science and technology base has resulted in the creation of small laboratory centers, each specializing in a scientific discipline or technology appropriate to Air Force needs. Only where the mission is broader in scope -- such as at RADC -- is a larger organization necessary. (19:59) The study group sees these technical centers as accomplishing two essential tasks: the promotion of new technology relevant to the Air Force mission and the transfer of technology

into Air Force systems and equipments. It is the latter area of technology transfer which the group feels needs the most attention. (19:60)

The perceived roles of the Air Force laboratories are generally accepted to include:

a. The laboratories must help the AFSC product divisions to become smart buyers. Gen Hendricks compares this to the shopper for an automobile who has acquired considerable experience in the operation and maintenance of his own car. He stays abreast of current technology and has a clear idea of his requirements. This enables him to make intelligent tradeoffs and be a smarter car buyer. In a similar vein, the laboratories help AFSC to stay sharp and awake. They are involved in the technology, and they assume an active, participating role in the systems acquisition process. (8:-) Colonel Patrick H. Caulfield, Director of Plans and Programs, AFSC/DLX, sees the laboratory role in this area as providing advice and consultation to the systems program directors, providing an active interface with both the Air Force Logistics Command and the using commands, and providing an independent assessment of the technical risk associated with new systems in the DSARC process. (6:-)

b. The laboratories must bring forth new technology. This includes such diverse things as selecting potential high payoff technology for development and then determining relevant applications. (6:-) In Gen Hendricks' opinion, laboratory involvement can make a significant contribution to systems acquisition by providing technology options. To be effective, these options must be made available to affect a timely transition to systems. (8:-) In order to accomplish this, the laboratories must develop the appropriate 6.1 and 6.2 programs which will, in time,

present the technology options required. (6:-) Guidance and direction are received by working closely with the systems developers and the using commands in the preparation and definitization of operational requirements, statements of work, systems specifications, requests for proposals, etc. (6:-) (8:-)

c. The laboratories must serve as an educator in the research and development arena. Col Caulfield points out that the laboratories have historically served as a vehicle to introduce many new officers and civilians to the research and development process. (6:-) The laboratories, more than any other AFSC organization, are able to introduce people to the intracacies and peculiarities of the AFSC systems development mission. The laboratories provide a transition for the young scientist or engineer from the civilian university or industry environment to the military way of doing business. After a tour in the laboratories, the individual is better equipped to serve in a SPO or engineering support role. (10:-)

d. The laboratories must provide direct support to systems. In this role the laboratories provide a cross-check of the work of the product division systems engineers. They are available to consult on problems as they arise or to otherwise assist the buyer as requested. This includes such things as participation in design reviews, source selection evaluations, failure analyses, etc. In these areas, Gen Hendricks' prime concern is that the laboratories be given the opportunity to get in the act early, rather than be called in to bail the developers out after the problems develop. (8:-)

Thus far, the perceived roles of Air Force research and development and the Air Force laboratory system have been discussed. In order to

ascertain the impact of realigning the command lines of the existing structure, one must first ascertain the reasons why such realignments are often proposed. In Section III the need for closer coupling between systems and the laboratories is discussed and examined in more detail.

SECTION III

DISCUSSION

The Need for Closer Coupling

So far the discussion has centered on what the laboratory involvement in the systems acquisition process ought to be. Obviously, a problem is believed to exist, or the subject would not be under constant scrutiny. Dr. John Allen, DDR&E (R&AT), believes that the DOD laboratories are not adequately participating in systems planning and acquisition. (13:22) Dr. Allen strongly agrees with the following comment from a 1971 DDR&E report:

> When responsibility for systems performance rests with a PM/SPO director and contractor, an in-house laboratory exerts little influence over the program -- when it does, it is usually in an advisory role and after the program gets into trouble. The laboratories' lack of direct involvement inhibits their ability to give sound, useful, timely advice. This management concept leaves little but job-shop or fragmented work for the laboratories to do in systems support (20:x)

Is Dr. Allen alone in this perception? Apparently not, for the AFLUS was conducted in 1974 in response to a memo to the services from DDR&E. The chartered purpose of the Air Force Study Group was:

> To assess the present Air Force laboratory operation and structure in terms of the contribution of the output to Air Force hardware and people programs; and to suggest steps that could be taken to improve the relevance and quality of the output while minimizing the cost of supporting the laboratories. (19:17)

The Study Group concluded that there is a need for closer ties to the user of the product. The laboratories are not transferring their acquired technology to Air Force systems with the effectiveness believed possible. (19:91) This problem is aggravated by the fact that laboratory products

are usually translated into systems applications by those industrial firms which do the development work through IR&D or under contract to the laboratories. (19:65) It is difficult to get one contractor to accept technology developed by another. Unless a contractor is comfortable with the technology, by virtue of the fact that he has experience with it, he is not going to propose it when attempting to secure a new development effort. Very little confidence is instilled by published technical reports and in-plant demonstrations.

In addition, in spite of the fact that the laboratories are often looked upon as a potential source of engineering manpower for the SPOs, most of the in-house laboratories are not staffed, funded, or properly equipped to provide much in the way of system support. (19:61) The overall break-out of laboratory effort in 1974 was roughly 90% applying and advancing technology and 10% direct systems support. (19:42) At ASD in FY 73 and FY 74 the figure ran about 5.2% (19:61) There are those who contend that this is woefully inadequate. Finally, the AFLUS concludes that, "A closer, well-defined relationship between product divisions and laboratories is needed." (19:93)

An opposing viewpoint contends that Air Force management is judging the laboratories by short-term products while expecting long-term technology breakthroughs. Concentration is devoted to detailed budget reviews with very little consideration given to long-term needs. (19:60) This may be due in part to the fact that very few high-level managers understand the nuances of Air Force laboratory management.

Brigadier General Phillip N. Larsen, Deputy Chief of Staff for Systems, HQ AFSC, essentially shares this belief. Gen Larsen feels that the laboratory

role should be limited to applied research, exploratory development, and advanced development with systems application in mind; but the laboratories should not become too directly involved in systems development per se. (12:-) The correct degree of coupling is illustrated by the procedure whereby the product divisions prioritize and comment on all laboratory 6.3/6.4 programs; and the DCS/Plans and Programs, HQ AFSC, does the same for programs not specifically associated with any product division. (13:12)

Finally, Lieutenant General James Stewart, Commander ASD, recently expressed the opinion that the laboratories should resist the temptation to become too closely coupled to systems development. He felt that the laboratories should concentrate on generic problems and avoid engineering development programs aimed at very narrow windows for specific systems. The Electronically Agile Radar Program, which is a growth option being developed at AFAL specifically for the B-1, is cited as an example. (23:-)

In summary, while the need for increased interaction and coupling between the laboratories and the product divisions is not universally perceived to exist, there is certainly a strong body of opinion which recognizes the need to do a better job.

Laboratory Support to Systems

Lest the reader believe that all is not well in the laboratory/production division relationship, at this point it may be appropriate to highlight some areas where things are going well. The laboratories are working closely with the SPOs in the development of systems specifications for new programs, RFP preparations and critiques, source selection evaluations, and assigned technical tasks -- both the planned and the unplanned variety. (8:-) The laboratories are also working closely with

the systems engineers in the functional organizations at the product divisions. For example, at Wright-Patterson AFB the aircraft engine specialists in the engineering directorate at ASD integrate their efforts with the propulsion scientists and engineers of AFAPL. The result of this integration will probably be an entirely new approach to the management of engine procurement through the creation of an "Engine SPO."

Not the least of the successes to date is the "investment strategy" process which has been developed to insure that the product divisions and the development planners have the appropriate measure of control and the opportunity to influence the expenditure of laboratory resources. The development planners of HQ AFSC and the product divisions prepare "development goals" which define the areas of interest and concentration for future efforts. Then, in conjunction with the laboratory planners, the group jointly determines a mutually acceptable strategy for the investment of laboratory resources. The resulting coordinated laboratory program should accomplish the long-range objectives. DDR&E(R&AT) and SAFRD have expressed great satisfaction with this approach to research planning.

The very serious operational problem posed by the catastrophic effect of the collision of a bird with the canopy of an F-111 aircraft is an example of a case where the SPOs do turn to the laboratories in time of trouble. The AFFDL and AFML marshalled their resources and developed an alternate windshield material for the F-111 aircraft. This material will absorb the impact of a bird strike during high speed, low-level flight and yet will remain intact, thus saving the aircraft and crew.

Unfortunately, this also illustrates a case where closer SPO/laboratory interaction during systems design might have prevented the problem entirely.

This experience has led to closer cooperation between the laboratories and the F-15 and F-16 SPOs in order to identify potential windscreen problems and to initiate an early start on a solution (6:-)

Barriers to Communication

The F-111 windshield problem serves to point up a lack of communication between the laboratories and the systems development community early in the systems acquisition process. This section of the report will outline the nature of the communications problem and point up some of the reasons for its existence.

The AFLUS concluded that there is a general lack of knowledge in the product divisions regarding laboratory capabilities and project goals. (19:92) A survey of program managers revealed little understanding as to the specific way laboratories are to contribute to systems development and acquisition. (19:60) The laboratories, in turn, are not aware of the technologies required by a particular system because the program managers do not always ask for assistance, and because the laboratories do not make the program managers aware of total laboratory capabilities. (19:70)

Simply stated, the SPOs and product division functional people appear to care little about what goes on in the laboratories. This attitude is more easily understood if one looks at it from the SPO point of view. For the program manager, cost, schedule, and performance are paramount. For a program in development, a 20% improvement may not be worth a 2% increase in program technical risk. Once the program manager has chosen a technical approach, he will not lobby for the selection of a growth option -- even if he believes it to be a wise choice. He is locked in by a system which has fostered a failure to communicate early in the system definition process. (8:-)

There is an interesting historical example to illustrate how it is possible to unwittingly erect barriers to communication in one's own organization. In the 1960s the Wright-Patterson AFB laboratories were the primary source of engineering manpower and support for the SPOs at ASD. In order to achieve closer coupling between the systems development community and the functional support community, the decision was made to split the engineering support function from the laboratories and assign it directly to ASD. The scientists and engineers were given a choice -- research and development or systems engineering. (14:-)

For whatever reasons, the result was that the bright young scientists and engineers tended to stay in the laboratories. Since promotion opportunities and freedom of action were enhanced in the laboratory environment, there developed a gradation between the laboratory and the product division scientists and engineers with respect to grade, pay, and ability. To compound the problem, the laboratory people came to be perceived and to behave like an elitest group. The ensuing barrier to communication became a barrier to the transfer of knowledge and technology from development to application. The engineers in ASD and the SPOs were very reluctant to turn to the laboratories for help. (14:-)

Lieutenant General John B. Hudson, who was then the Vice Commander of ASD, perceived this barrier to communication and suggested that the best way to overcome it was to reorganize the laboratories at Wright-Patterson AFB and assign them directly to ASD. The group formed by Gen Hudson to study the problem and present alternatives and recommendations became known as the Hudson Committee. Two of the members of the Hudson Committee, Dr. Alan M. Lovelace, Deputy Administrator of NASA, and Major General John C.

Toomay, DCS Plans & Programs, HQ AFSC, reported that the study was largely inconclusive since specific recommendations were neither made nor implemented. However, there was general agreement that the laboratories should be more responsive to systems. (14:-) (23:-)

Another barrier to communication may be found in the organization of the SPO itself. It has been the practice in the development of major weapons systems for the Air Force to create "Super SPOs" (e.g., F-15, B-1) which are vertically organized and completely self contained -- a "silo" approach. The "silo" approach fostered the attitude in the SPOs that there was no need to look outside the organization for assistance. Since help was not sought, information did not flow in. Conversely, neither did it flow out. Because mistakes and lessons learned were not communicated throughout the development community, they were bound to be repeated by others (8:-)

Col Caulfield has identified some other barriers. He feels that the SPO people naturally resist laboratory involvement. "no one likes free advice on raising his kids -- until they get in trouble." Also, the laboratories are often looked upon as similar to an IG -- as an antagonist rather than as a partner in the enterprise. Often the laboratories disagree with a prime contractor's technical position, and the SPOs prefer to avoid disturbing factors. They are hesitant to surface problems. Increased risk (or acknowledgement of existing risk) could kill the program. (6:-)

Gen Hendricks believes that AFSC is very much aware of the necessity to improve the communications process between the laboratories and the product divisions. He points out that the command is leaning away from the "silo" concept and more toward a matrix approach of program management

in an attempt to address this problem. The objective is to stimulate the cross fertilization of ideas. A functional cut at the organization tree may be the best solution. (8:-)

The Changing Emphasis on Research and Development

By this time the reader is probably convinced that the management interface between the laboratories and the product divisions is not as clearly defined as one would like. In addition to an appreciation of the barriers to communication which exist, the reader should understand that the Air Force itself cannot seem to make up its mind on the proper emphasis to be placed on research and development. The AFLUS contains an excellent summary of this aspect of the problem. Some excerpts are enlightening:

> To a large extent the manifold organization realignments implemented over the history of the laboratory organizations have been prompted by the desire to shift emphasis either toward or away from applied problems. (19:31)

> In the early 1960s, as a result of the emphasis accorded by Secretary McNamara and others, a major effort was instituted to improve the in-house laboratories of all three Services. Following a number of studies...it was decided in 1963 to place the Air Force laboratories under a new division of AFSC, the Research and Technology Division. During its lifetime, RTD stressed the technology base, and less emphasis was placed on technical support to the product divisions. In 1967, as a result of the increased Southeast Asia activity, it became evident that additional assistance from the laboratories with current Air Force problems, as well as in long-range technology was required. About 1968, RTD was disestablished and the laboratories were placed directly under a Director of Laboratories (DOL) within HQ AFSC. Under the DOL and the subsequent Director of Science and Technology, the laboratories have functioned in both roles of developing the technology base and of supporting the product divisions.
>
> The notable aspect of the laboratory histories is the shift from product orientation to research and back again. On a rough time scale of a decade the orientation of the laboratories has been redirected. The long sought after

> solution is one which maximizes the technical support to hardware development without degrading the quality of the long range technology efforts. (19:33)

Dr. Bernard A. Kulp, Chief Scientist, Office of the Director of Science and Technology, HQ AFSC, has developed a cogent explanation of the forces which cause the pendulum swing from systems development to research and back. Dr. Kulp believes that a relatively constant supply of resources (manpower and dollars) coupled with a cyclic demand for hardware and technology accounts for the periodic shift.

During a period of emphasis on technology, the laboratories enjoy the resources and the relative organizational freedom and independence to concentrate on building the technology base. With the technology in hand, the emphasis then shifts to developing systems and bringing them into the inventory. The laboratories endure a period of dwindling resources and increasing constraints on the scope of their activities. Organizational changes to tie them closer to the product divisions are proposed. The pendulum reaches the extreme of its swing.

As the new systems complete development and begin to appear in the inventory, the need is perceived for a strengthening of the technology base which has suffered through neglect during the period of emphasis on systems. Manpower, financial resources, and increased freedom of action return to the laboratories, and the cycle repeats. Dr. Kulp predicts that the current era of systems emphasis is drawing to a close and that the laboratories will enjoy unprecedented freedom, independence, and resources by 1985. (10:-)

Gen Larsen is not certain that Dr. Kulp's cyclic model completely describes the behavior of the system, although he does agree that at present there is a decrease in the emphasis on technology and an increase in the

emphasis on systems. (12:-) Dr. Lovelace agrees that while the laboratories may not have been responsive at one time, they are responsive now -- perhaps overly so. He cites the aforementioned remarks of Gen Stewart as an indication that the laboratories may be overdoing the relevance to systems. (14:-)

The center of gravity of Air Force research and development may have shifted more to the development end than is generally realized. The Air Force should attempt to reballast the center of gravity, although it can never, and probably should never go all the way back to the research end. (14:-) Dr. Lovelace also points out that the nation as a whole is moving away from research. Inasmuch as we are living now on investments made ten to twelve years ago, it is a matter of national concern.

Advantages of Reorganization

So far the discussion has centered on the need for closer coupling between the laboratories and the product divisions, the communications barriers to improved relationships, and the nebulous nature of the problem created by the uncertainty surrounding the proper emphasis of research and development in the systems acquisition process. In this section, the advantages associated with one of the obvious solutions -- assigning the laboratories to the product divisions -- will be addressed.

The proposal has numerous advocates. The AFLUS report proposed that the laboratories be assigned to the product divisions or centers on the basis of related missions and capabilities. The DL staff would lose its line responsibility and revert to a staff function with responsibility

to integrate science and technology across the command. This would improve personnel mobility and facilitate systems support.[1] (19:78)

A study performed for ESD in 1970 advocated a similar organizational realignment to improve the acquisition of Air Force command, control and communications (C^3) systems. A single commander would have overview of the entire C^3 development process with the attendant advantage of achieving centralized planning to provide a perspective and cohesiveness to the total program. (4:17) The inference being that research and development work that does not recognize the need for relevance to the military system of the future may be interesting and may add to the overall store of knowledge, but it is not likely to find direct application to the operational inventory. (4:12)

A realignment would have the beneficial effect of marrying the product division technology planners to the laboratories. This would enhance the laboratories' involvement with requirements, evolve systems concepts, and advance development programs. In addition, planning and mission analysis would be improved along with programming and systems advocacy. The net result would be a closer link with the user. (18:-)

Col Caulfield admits that assigning the laboratories to the product divisions would tend to enhance the transfer of technology to the user. It would keep the researchers in closer touch with reality and more aware of current problems. Col Caulfield cautions that it is the laboratory managers who are the ones who should be in touch. The scientists and

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[1] Lack of personnel mobility was one of the primary concerns of Gen Hudson when he formed the Hudson Committee. He felt that personnel mobility in and out of the laboratories/product divisions would overcome the "elitest" barrier to communication.

engineers in the operating level of the organization should be kept isolated from the day-to-day distractions of the environment. (6:-)

Gen Hendricks also believes that the work of the laboratories would tend to line up more with the primary mission of the product division. Because of the problems in the C^3 area, this rationale was used to justify assigning RADC to ESD. (8:-)

Also, it is believed by some that having the laboratories report to a commander in Washington DC makes the management of the effort in support of systems cumbersome. On the other hand, administrative management is less adversely affected by span of control distance. Finally, the availability of know-how to the product division becomes questionable. (16:6)

Gen Toomay sums it up nicely with the thought that if the laboratories become too independent, they may become an entrenched bureaucracy with all its concomitant ills. The danger is that the laboratories might become intellectually isolated. Gen Toomay appreciates the advantages to be gained, but he also appreciates the disadvantages. He feels that what is needed is a compromise. The laboratories should come under the discipline of both higher headquarters and the product divisions. (23:-)

Disadvantages of Reorganization

What then are some of the disadvantages Gen Toomay cautions us about? The one that is almost universally accepted is the concept that the technology base would atrophy or erode. Gen Toomay refers to it as "mortgaging the future to pay for the present." (23:-) The AFLUS concludes that assigning the laboratories to the product divisions would, in the long term, degrade the technology effort because of increasing demands of current problems on top management time and on organizational resources. (19:78)

Dr. Lovelace describes the problem very clearly. When the research and development system concentrates too much in the development mode, top level management becomes enmeshed in real, important, near-term problems. These problems become voracious consumers of the manpower and resources at the disposal of the manager. Consider the commander of a product division who is confronted with a major problem on a system in development. Can one picture him not devoting all the resources at his disposal to the problem? One can imagine him saying, "We cannot protect laboratory resources in order to invest in tomorrow. If this problem is not solved today, there may be no tomorrow!" (14:-)

Col Caulfield provides additional insight into the mechanisms of the erosion of the technology base which would inevitably result. The laboratories would gradually assume the character and complexion of a system support organization -- systems engineers as opposed to scientists and researchers. There would be no isolation of the scientists and engineers from the product division staff. The product divisions would look to the laboratories as low priority areas to be sacrificed whenever manpower and budget cuts were levied by higher headquarters. (6:-) These events have been observed to occur at Eglin AFB, where AFATL reports directly to ADTC. There is a tendency to reprogram funds from the technology lines to the product lines in order to solve budgetary problems. Also, manpower shortages in the systems areas have been addressed by directing the collocation of laboratory people from the laboratory to the center's engineering support function.

Under the present system, the intervention of higher headquarters, SAFRD, and DDR&E serve to protect the technology base. Placing these

resources under the direct control of the product divisions would make the task more difficult. (8:-)

Dr. Lovelace also asks the question, "What happens when the development mission is complete?" Can the product division redirect the people back to research? Would they? He suggests that experience indicates not. (14:-) As a result of being closer to systems, people will gradually become more systems oriented as opposed to technology oriented. (18:-) These people now know the current system. They grow comfortable, and do not want to become involved in new problems. They eventually become an impediment to future improvement. (14:-)

Last, but not least, would be the detrimental impact on the proposed independent technology assessment which has been directed by DDR&E for all DSARC programs. Hardlining of the laboratories to the product divisions is bound to deter an objective assessment of the technical risk beyond the level of the product division itself. (13:39)

As Gen Hendricks so aptly put it in perspective, "The advantages to be gained by the realignment are outweighed by the disadvantages. We require the restraints, inhibitors, and insulation provided by assigning the laboratories to DL. On the other hand, we continue to improve our way of doing business to better support the systems developers. This can best be achieved by an independent laboratory system." (8:-)

The Need for Independence

Perhaps the most formal statement of a need for independence can be found in the final report of the DOD laboratory utilization study group. It was here that the recommendation was first made that the laboratories be required to provide an independent technical assessment as part of the

DCP/DSARC process for new programs. (3:xii) Although the Air Force has expressed strong opposition to the idea of a Technology Assessment Annex to the DCP, there still exists a very real possibility that the basic concept may be implemented in one form or another. Therefore, independence must be maintained. (11:1)

Gen Toomay believes that the laboratories must maintain their independence while striving to achieve a close association with the product divisions. This independence can be retained only by means of a direct line to higher authority. (23:-) Gen Hendricks agrees. The laboratories should be fully involved in a full-spectrum environment, but they must retain their autonomy and independence. Their role includes being strong, independent advocates, advisors, and critics. If not independent, they become a part of the system, or become identified too closely with it, and hence lose credibility. (8:-)

Exceptions to the Rule -- AFATL & RADC

By virtue of the fact that most knowledgeable authorities have extolled the advantages of an independent laboratory system, the astute reader has probably asked, "Why is there a different organizational alignment between AFATL & RADC and the other AFSC laboratories?" Naturally, there are exceptions to every rule, and this rule can probably be best stated, "The laboratories are most effective overall when they report to HQ AFSC; however in order to build a new capability, they may be assigned to a product division as an interim measure." (10:-) Such was the case with AFATL and RADC.

Consider first the situation at ADTC. Major General Jewell Maxwell assumed command of ADTC in about 1969. The Southeast Asia conflict was in full

swing, and ADTC was heavily involved in munitions system development, although it was not considered a product division in the true sense of the term. The organization did not employ the systems program office concept and had a history of a lack of management structure.

Gen Maxwell arrived to find an engineering development division with approximately 150 engineers, fewer than he deemed necessary to provide sufficient technical capability to support the munitions development mission. He felt he lacked a critical mass of manpower and expertise. Gen Maxwell saw in AFATL the solution to his problem. He saw in the laboratory a strong, well-managed organization with technical capability and with the potential of REFLEX.[1] Gen Maxwell was able to solve both the management and manpower problems by reassigning the munitions development mission back to the laboratory. Here was the organization, technical capability, and -- through REFLEX -- the numbers of people needed to get the job done. In exchange, Gen Maxwell had to have control, so AFATL came under direct control of ADTC (10:-)

That situation no longer obtains, however. There are now several major systems development programs at ADTC. The Center has been reorganized into a SPO system and will probably soon be declared a product division. Engineering development has been moved again, this time from the laboratory

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[1] Project REFLEX (Resource Flexibility) was a Department of Defense demonstration project which involved ten DOD in-house laboratories (including AFATL)... These laboratories were allowed to operate without manpower ceilings, i.e., local laboratory management was given freedom to adjust personnel levels to match workload requirements and available funds. According to a report by the GAO, REFLEX improved the planning for and matching of funds, workload, and manpower; delegation of responsibility and authority to lower management levels was encouraged; management was provided with a wider range of make or buy options; costly and time-consuming administration associated with personnel ceilings was reduced; and efficiency and productivity was enhanced... (19:64)

back into the Systems Division. With over 400 personnel, it now exceeds the critical mass. The laboratory is now more normally involved in 6.2 and 6.3 programs and will provide support to ADTC on an ad hoc rather than a continuous basis. (10:-) In short, the reasons for AFATL to be an exception to the rule no longer exist. Good management would then dictate that AFATL should be realigned to HQ AFSC.

The organizational alignment of RADC presents an entirely different problem. A report on the Air Force Systems Command Reposturing Actions FY 1976 concluded that, "The single most critical management problem within AFSC is that of providing technology support to ESD's command, control, and communications acquisition mission." (2:10) Gen Toomay agrees the problem is complex. "C^3, C^3, C^3...nobody knows what it is! Software...We can't buy it...We can't estimate how much it costs." ESD needs help badly, and AFSC has concluded that the technology support provided by the existing laboratory structure to the ESD C^3 mission is inadequate. (23:-) (2:6)

At this point, it is important that the reader understand that the proposed Air Force solution to the needs of ESD was to disestablish RADC at Griffiss AFB, New York; disestablish the Air Force Cambridge Research Laboratory (AFCRL) at Hanscom AFB, Massachusetts; create a new geophysics laboratory at Kirtland AFB, New Mexico; and create a new C^3 collocated laboratory with ESD. The new C^3 laboratory would be comprised of assets from both RADC and AFCRL.

Although from a management sense, this solution was eminently practical it was politically unacceptable. In the political turmoil which ensued, a special study group was formed to advise the Secretary of the Air Force on the management and support of C^3. (22:-) In an attempt to provide ESD

with a systems engineering group which would provide technical expertise and corporate memory to the management of C^3 development, the study group recommended the establishment of a systems engineering group at Hanscom AFB comprised of ESD, RADC, and AFCRL resources. It is also recommended that laboratory people be collocated in the SPOs and then rotated back to the laboratories to refurbish their expertise. This scheme is intended to provide training capability, a built-in technology transfer process, and an assured, competent systems engineering base for ESD. (22:20) The final decision of the Secretary resulted in the partitioning of AFCRL into a geophysics laboratory (AFGL) to remain at Hanscom and a C^3 group to be organizationally assigned to RADC as a detachment at Hanscom. RADC, in turn, would remain at Griffiss and assume the role of C^3 systems engineering support to ESD. The Secretary concurred in the study group's recommendation that because of the increasing national importance of C^3 over the next decade, it is vital that the commander of ESD have tight control of the laboratory assets in support of C^3. (22:21) For the time being at least, RADC will report to ESD. The study group did recognize the fact that DL should retain control of the 6.1 and 6.2 activities of the laboratory in order to provide protection of the technology base. (22:21)

In short, RADC is an exception to the rule because ESD needed a source of manpower to absorb the increased money and complexity represented by the significant expansion of the C^3 mission. RADC and AFCRL provided the sources.

A Workable Alternative

The tenacious reader may recall that the objective of this analysis was to help locate the proper interface between the laboratories and the

product divisions in order to improve the systems acquisition process. By now he should be convinced that the proper interface is one in which the systems development community has a great deal to say about major laboratory activities. It is not necessarily one in which the product division commander has organizational control of the laboratories.

Historically, the environment has determined the organizational relationship with the laboratories. Direct command authority has not proved essential, but physical proximity is another matter. Experience has shown that physical proximity is not required for 6.1, 6.2, and 6.3 efforts in established organizations. However, for direct consultation and support to a program office, physical proximity is beneficial, and collocation is optimum.[1] (22:22) In providing rationale for the establishment of a C^3 laboratory to support ESD, the report on the FY 76 Air Force reposturing actions emphasized the AFSC belief that physical proximity between the product division and the supporting laboratory is essential to provide a perspective and cohesiveness to the total C^3 program, to develop in-house resources, to provide an optimum means for technology transfer in the systems engineering process, to provide a surge capability to meet urgent and peak workload requirements, and to provide maximum flexibility in the application of resources. (2:7) The report goes on to express the opinion that physical proximity plus a "proper management alignment" of the laboratory and the product division will provide significant improvements to the interface problem. (2:TAB A, p9)

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[1] In this sense, physical proximity means the laboratory and program office are located on the same military installation, and collocation means laboratory and functional area personnel are located in the program office itself.

What then is the, "proper management alignment?" There are many indications that the formal reporting structure is not important. Dr. Lovelace believes that Gen Stewart could have made any organizational arrangement of ASD and the Wright-Patterson AFB laboratories work. Through the force of his personality and leadership, any laboratory commander would do anything Gen Stewart requested. (14:-) The AFLUS concluded that with adequate numbers of good people, the organization is not important. Without good leaders, no organization will work at all. (19:61)

The key then is the people. Laboratories and SPOs are different; it is the nature of the beasts. (6:-) But people can bridge the gap by providing the necessary infusion of knowledge and experience. Therefore, the proposed "long sought after solution" is one which minimizes the effect of the organization and maximizes the impact of the people. AFSC has already begun to move in the proper direction by placing less reliance on the "aggregate" or "silo" organized "Super SPOs" and placing increased emphasis on matrix approaches to program management.

Dr. Lovelace contends that the ideal interface between the product divisions and the laboratories is the organizational matrix in which the laboratories report to DL but are called upon as any other functional organization. The systems people know the requirements and the intracacies of systems development, and the laboratory people know the intracacies of the technology. (14:-) Together they form a complementary team in which the laboratories have the capability to provide technical and engineering support to a SPO. (14:-) Under this arrangement, the laboratories maintain their technical independence and are able to couple technical competence with freedom of action. When necessary, they can provide independent

technical reviews to supply the program manager with an improved information base to make decisions. By collocating laboratory people in the program office, the program manager will have an organization with greater technical breadth and will be able to draw upon the full resources of the laboratory when needed. The laboratory director, on the other hand, will benefit from having real time problems brought back to his laboratory and still be able to concentrate the major portion of his resources on the development of the technology base. The beneficial result will be a broad spectrum laboratory under the discipline of both DL and the product division. The laboratories will provide support to systems and yet retain the technological initiative.

SECTION IV

CONCLUSIONS AND RECOMMENDATIONS

Conclusions

This study has focused attention on the interface between the laboratories and the systems development community within the Air Force. Although the problem is very complex, and many divergent viewpoints are strongly held; the following conclusions appear reasonable:

- The Air Force laboratories are doing a good job and are held in high regard by those in the systems community who use their products and their services.

- The laboratories are working very closely with the development planners and the product divisions in order to more wisely determine the best "investment strategy" for the employment of laboratory resources.

- The laboratories respond very well to calls for assistance when problems arise such as with the F-111 windshield.

- In spite of the above, the opinion persists that the amount and intensity of coupling between the systems program offices and the laboratories needs to be improved.

- The primary role of the laboratories is to make the Air Force a "super educated buyer." In doing this, they have the responsibility to develop and maintain the technology base and then transfer the technology to systems.

- There are barriers to communication between the laboratories and the product divisions.

- Assigning the laboratories to the product divisions would probably have numerous beneficial effects. Planning would be improved

by more clearly defining concepts and requirements, providing a better basis for mission analysis and advocacy, and providing a closer link to the user. Other improvements would accrue in the areas of systems support, technology transfer, command span of control, and enhanced personnel mobility. In addition, the danger of the laboratories becoming an entrenched bureaucracy, intellectually isolated from the systems community, would be averted.

- The advantages cited could only be realized at considerable cost. The most serious and unacceptable cost would be the erosion of the technology base. The gradual redirection of manpower and funds from basic and applied research to systems engineering and development would solve near-term problems at the expense of future capability. The laboratories would lose their independence and hence their credibility. There are other ways to achieve the advantages cited above without endangering the technology base.

- AFATL and RADC are each unique in the problems they present. The original justification for assigning AFATL to ADTC no longer exists. The problems associated with developing a strong, viable C^3 capability in the Air Force has created a need at ESD for the type of support which can only be provided by a C^3 laboratory.

- A solid working interface between the laboratories and product divisions is best obtained when both are located in geographical proximity. The situation is further enhanced by collocation of personnel.

- The "long sought after solution" is not really a function of the organizational structure. It is the people who are important. If the commander of the product division had an appreciation of the value of

the technology base, he would protect it. However, in the absence of guarantees, it is wise to avoid potential erosion of laboratory resources. Instead, the laboratories should be looked upon by the product divisions as another source of functional expertise. This expertise is available through the collocation of laboratory people in program offices as required.

Recommendations

The present organizational structure of the laboratory system, which has evolved over the years and has been influenced by cyclic changes of emphasis and direction, should be retained. The independence which has been imbued in the present system is essential to the preservation of the technology base.

The laboratories can and should be encouraged to operate in a full-spectrum environment. This encouragement, coupled with increased effort to integrate the laboratory and product division planning through the development goals and investment strategy process will serve to break down the barriers and improve communications between the participants.

The organizational alignment of AFATL and ADTC should be changed. AFATL should report to HQ AFSC just as do the other technology laboratories. On the other hand, the C^3 problem at ESD calls for more drastic organizational changes than have so far been made. Even though RADC has been "dedicated" to the C^3 effort and assigned to ESD, the lack of geographical proximity dooms this arrangement to only partial success. Therefore, if at all possible in the light of political constraints, the original plan of creating a C^3 laboratory and a systems engineering group of critical mass at ESD should be pursued. The demise of RADC at Griffiss may be an unfortunate but necessary corollary event.

As AFSC swings more to applying the matrix approach to the management of its weapons system development efforts, it should likewise look more to the laboratories for functional and technical support. The expertise is available and can best be utilized by collocating laboratory people in the product divisions and SPOs.

Finally, the best overall recommendation was suggested by Colonel John Brooke. The laboratories want to strongly support systems development, but they must protect the technology base. As the "laboratory" moth circles the bright, attractive flame of the "systems" candle, he has an almost overpowering desire to get closer and closer. The perfect balance is struck when he "hangs tight and tough" -- and survives. (5:-)

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18. O'Neill, John W., Lt Gen, USAF (Ret.) Unpublished transcript of a public meeting of the Command, Control, and Communications Management and Support Study Group, 10 April 1975.
This meeting, one of a series conducted by Lt Gen O'Neill, was held in Room A-312, Building 1535, HQ AFSC, Andrews Air Force Base.

Maryland, as part of a fact-finding study to assist the Secretary of the Air Force to make a decision on the proposed disestablishment of the Rome Air Development Center at Griffiss AFB, New York.

19. Report of the Special Study Group on the Utilization of the Air Force Laboratories, Headquarters, Air Force Systems Command, Andrews Air Force Base, Maryland, August 1974.

20. Report of the Task Group on Defense In-house Laboratories, Office of the Director of Defense Research and Engineering, Washington, DC, 1 July 1971.

21. Report of the USAF SAB Ad Hoc Committee on the Air Force Support of Research, USAF Scientific Advisory Board, Department of the Air Force, Washington DC, December 1970.

22. Report to the Secretary of the Air Force Study Group on Management and Support of Command, Control, and Communications, USAF Scientific Advisory Board, Department of the Air Force, Washington, DC, 28 May 1975.

23. Toomay, John C., Maj Gen, USAF, Interview at AFSC/XR, Andrews AFB, Maryland, on 4 October 1976.
Major General Toomay is presently the Deputy Chief of Staff, Development Plans, at Air Force Systems Command Headquarters. He formerly served as the Commander, Rome Air Development Center, and on the staff of the Deputy Chief of Staff for Research and Development, USAF Headquarters. Gen Toomay was also a member of the Hudson Committee.